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Risks of ocean acidification in the California Current food web and fisheries: ecosystem model projections

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Abstract

The benefits and ecosystem services that humans derive from the oceans are threatened by numerous global change stressors, one of which is ocean acidification. Here, we describe the effects of ocean acidification on an upwelling system that already experiences inherently low pH conditions, the California Current. We used an end-to-end ecosystem model (Atlantis), forced by downscaled global climate models and informed by a meta-analysis of the pH sensitivities of local taxa, to investigate the direct and indirect effects of future pH on biomass and fisheries revenues. Our model projects a 0.2-unit drop in pH during the summer upwelling season from 2013 to 2063, which results in wide-ranging magnitudes of effects across guilds and functional groups. The most dramatic direct effects of future pH may be expected on epibenthic invertebrates (crabs, shrimps, benthic grazers, benthic detritivores, bivalves), and strong indirect effects expected on some demersal fish, sharks, and epibenthic invertebrates (Dungeness crab) because they consume species known to be sensitive to changing pH. The model's pelagic community, including marine mammals and seabirds, was much less influenced by future pH. Some functional groups were less affected to changing pH in the model than might be expected from experimental studies in the empirical literature due to high population productivity (e.g., copepods, pteropods). Model results suggest strong effects of reduced pH on nearshore state-managed invertebrate fisheries, but modest effects on the groundfish fishery because individual groundfish species exhibited diverse responses to changing pH. Our results provide a set of projections that generally support and build upon previous findings and set the stage for hypotheses to guide future modeling and experimental analysis on the effects of OA on marine ecosystems and fisheries.

Keywords: California Current, climate change, ecosystem model, fisheries, ocean acidification, risk assessment

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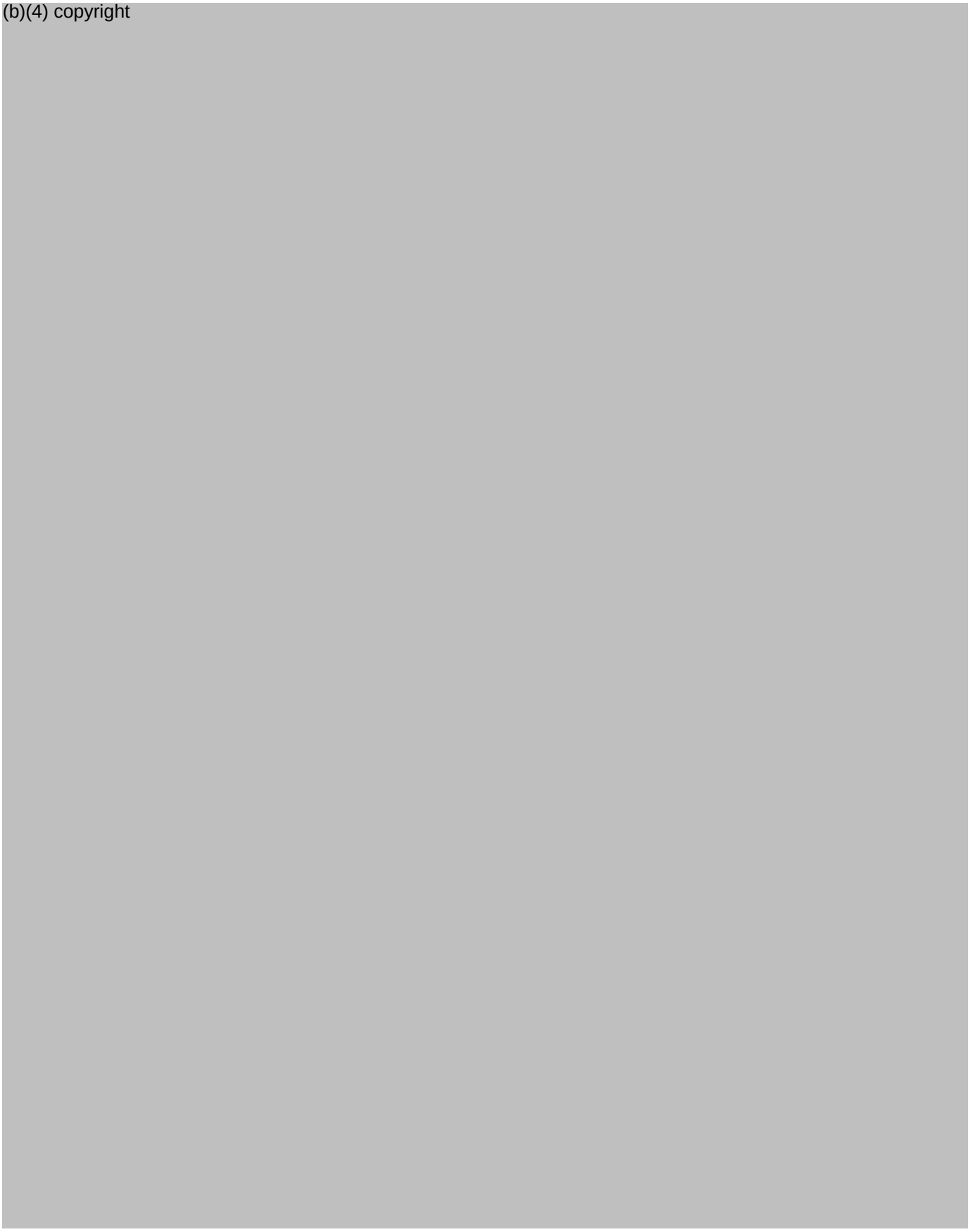

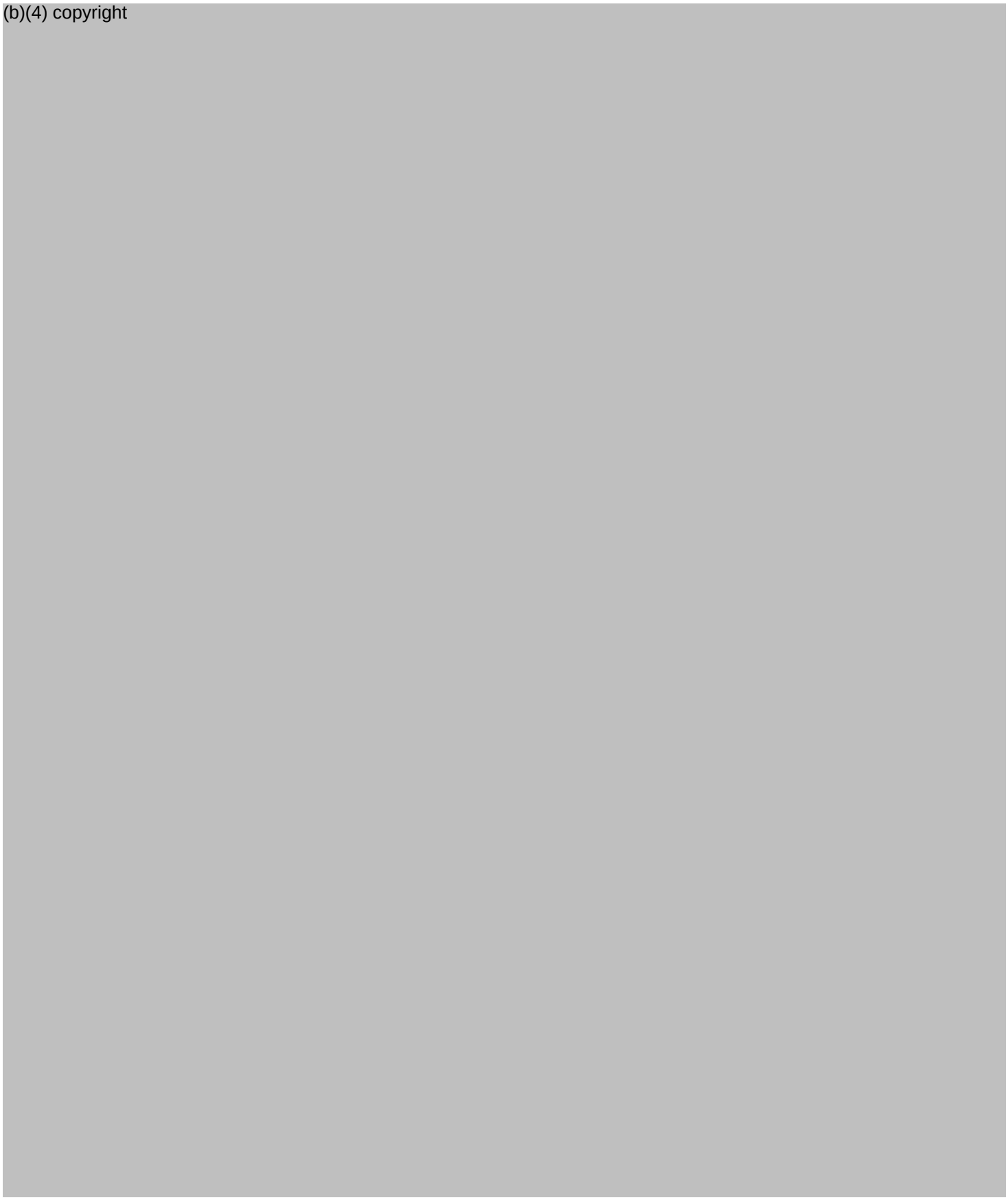

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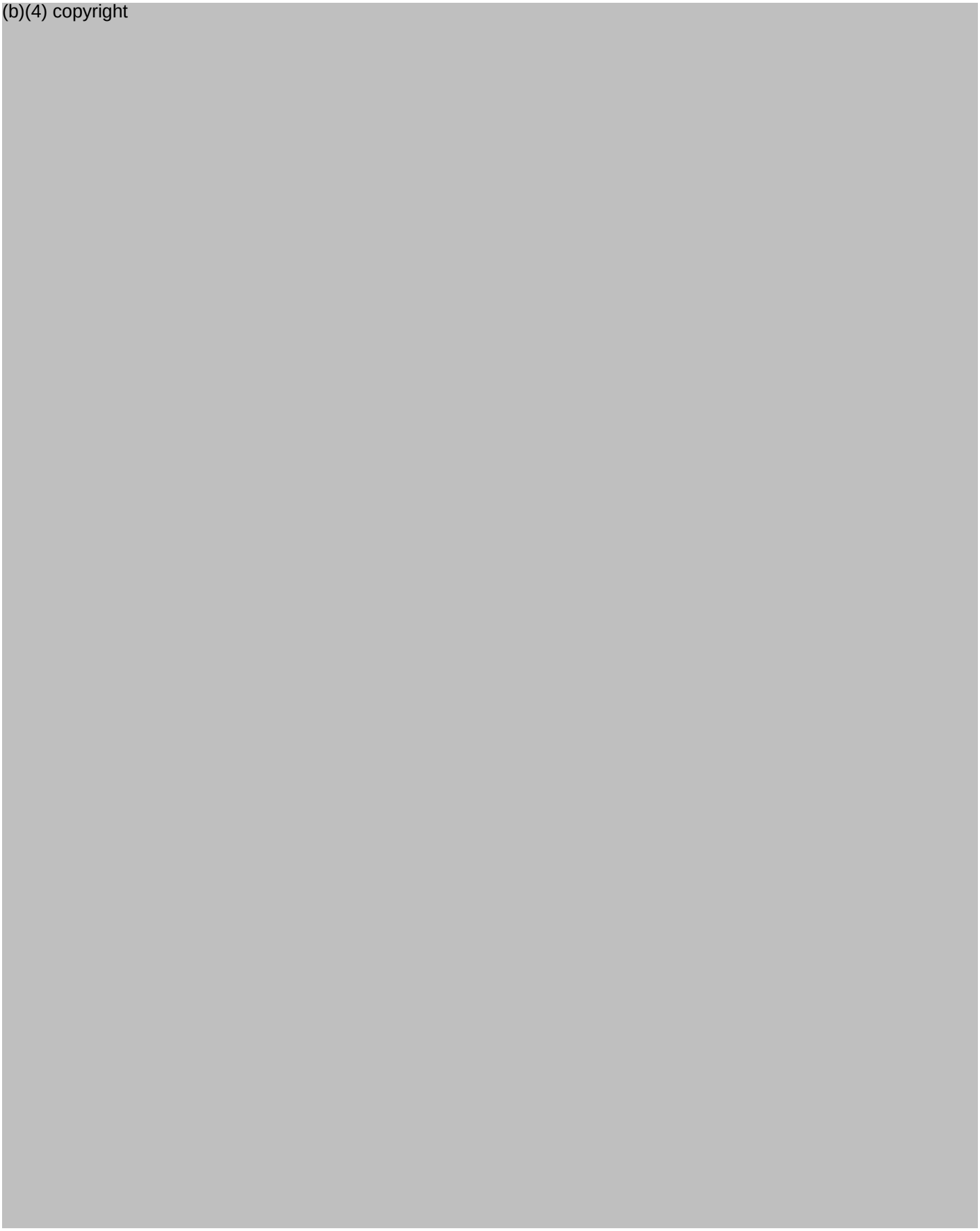

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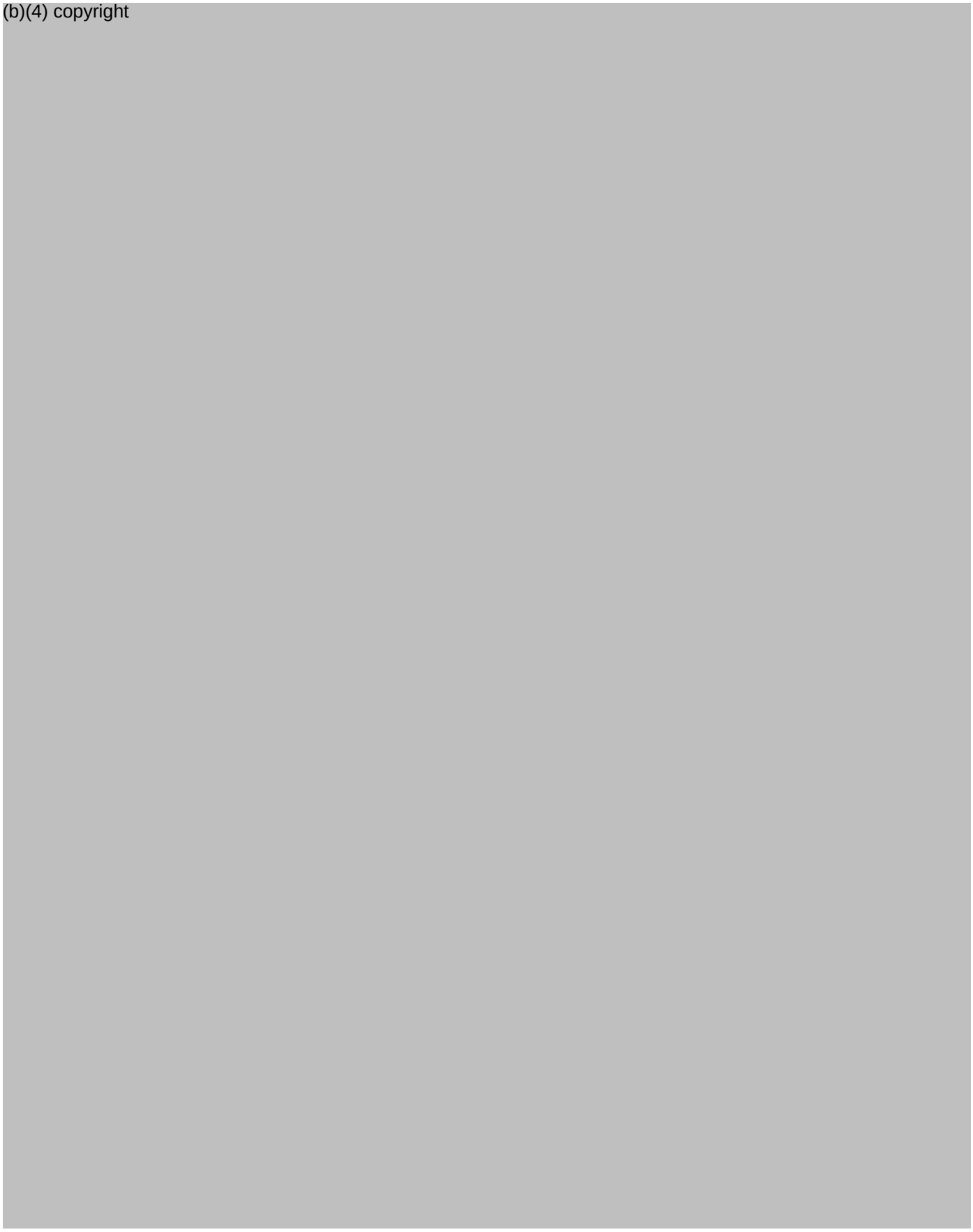

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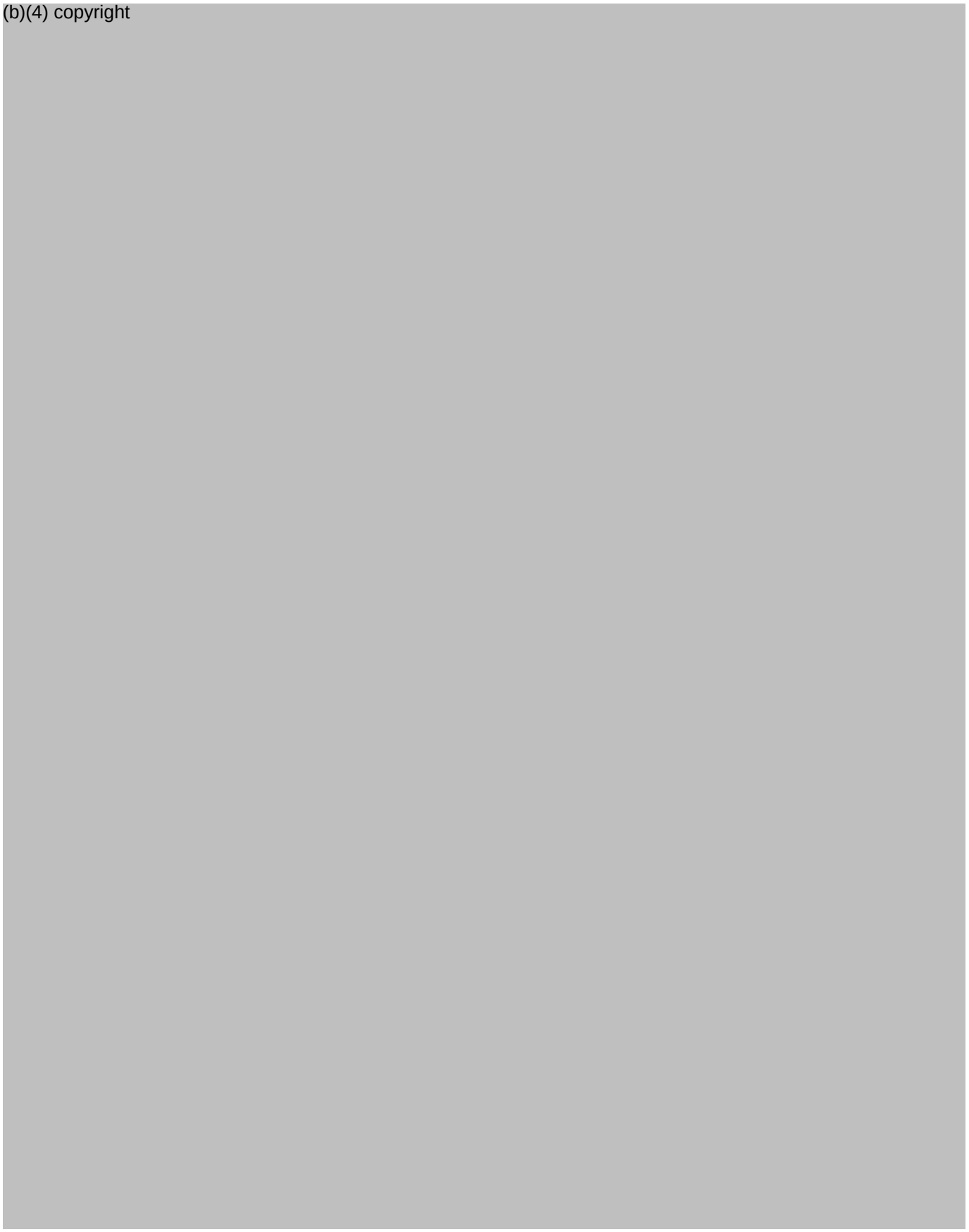

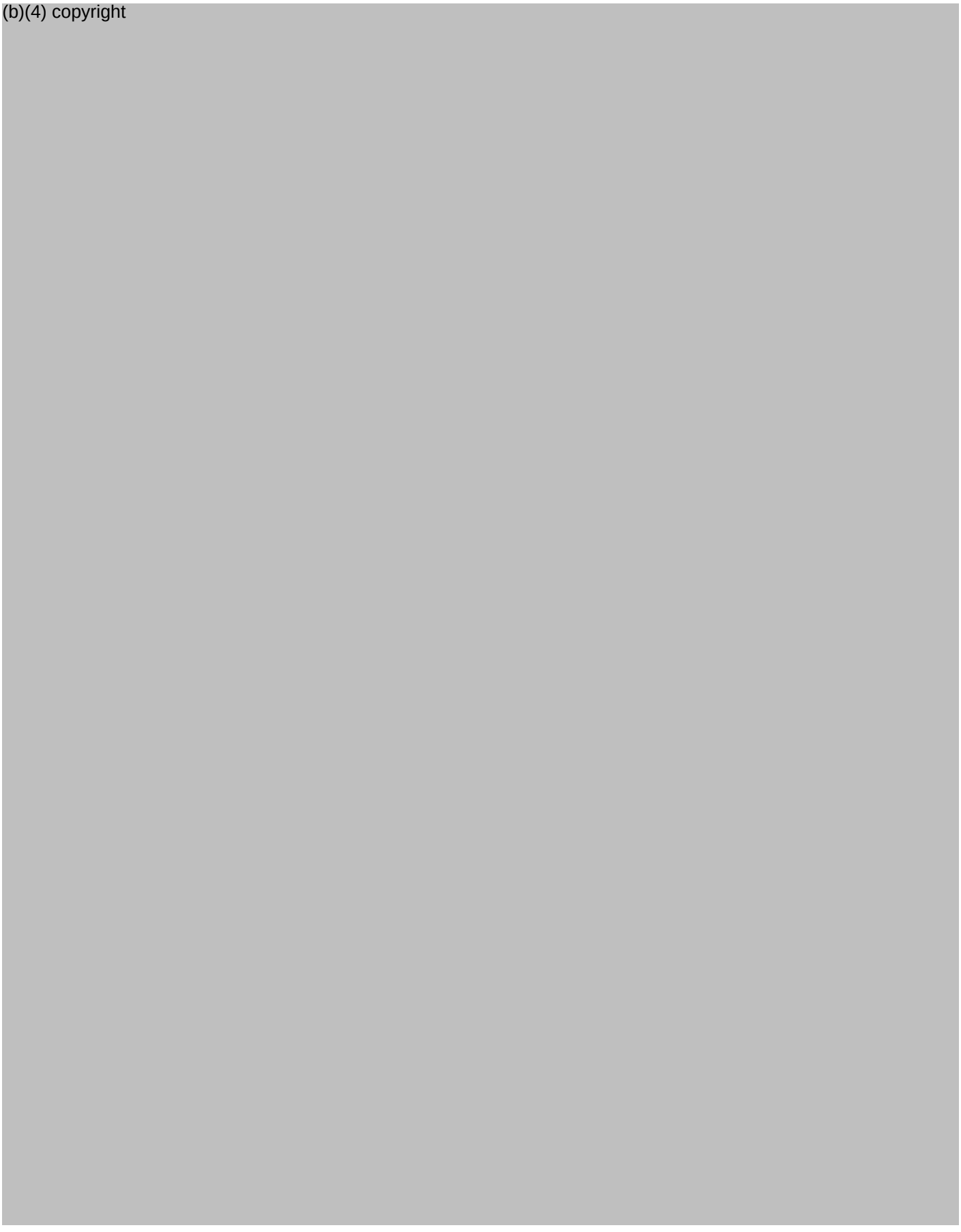

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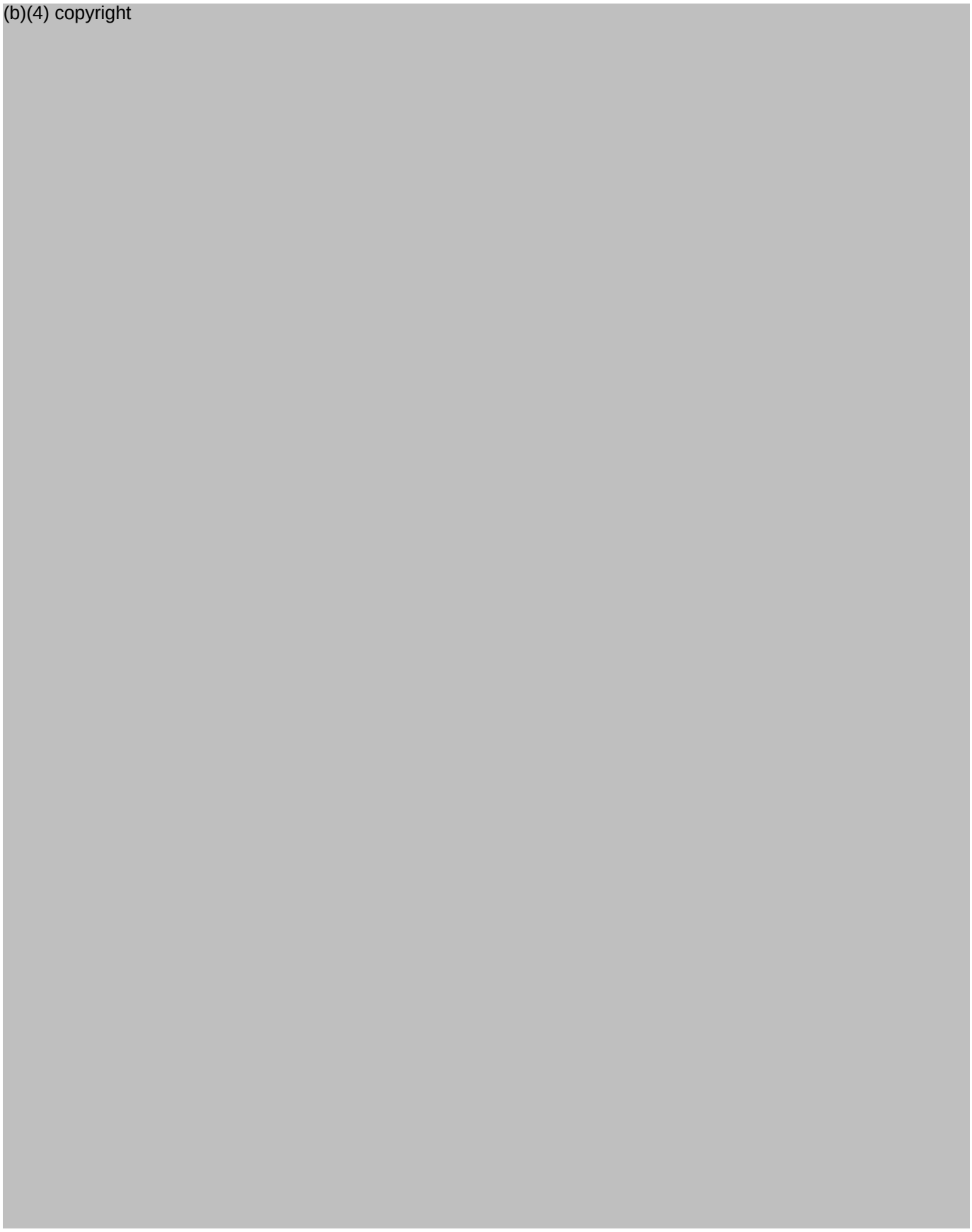

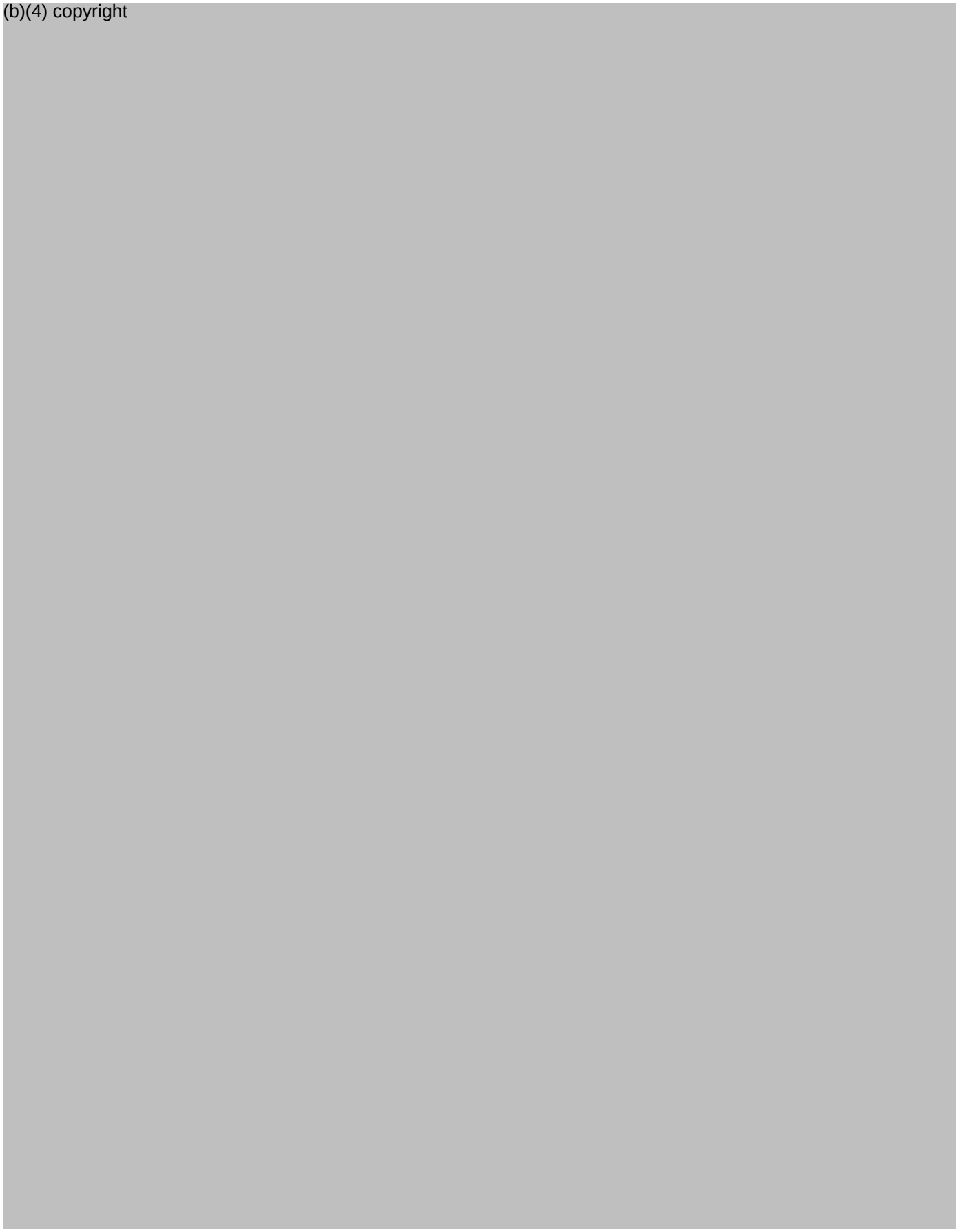

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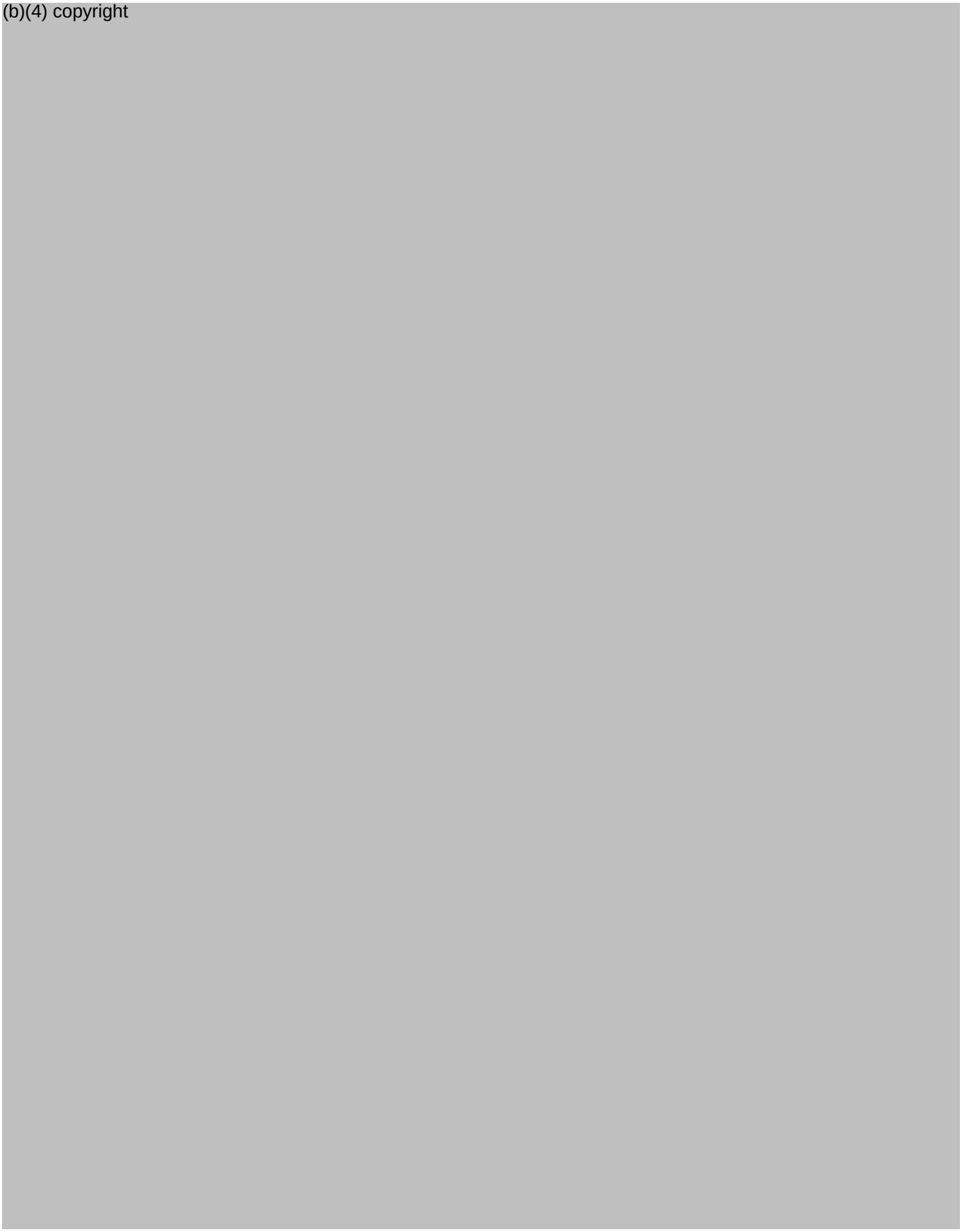

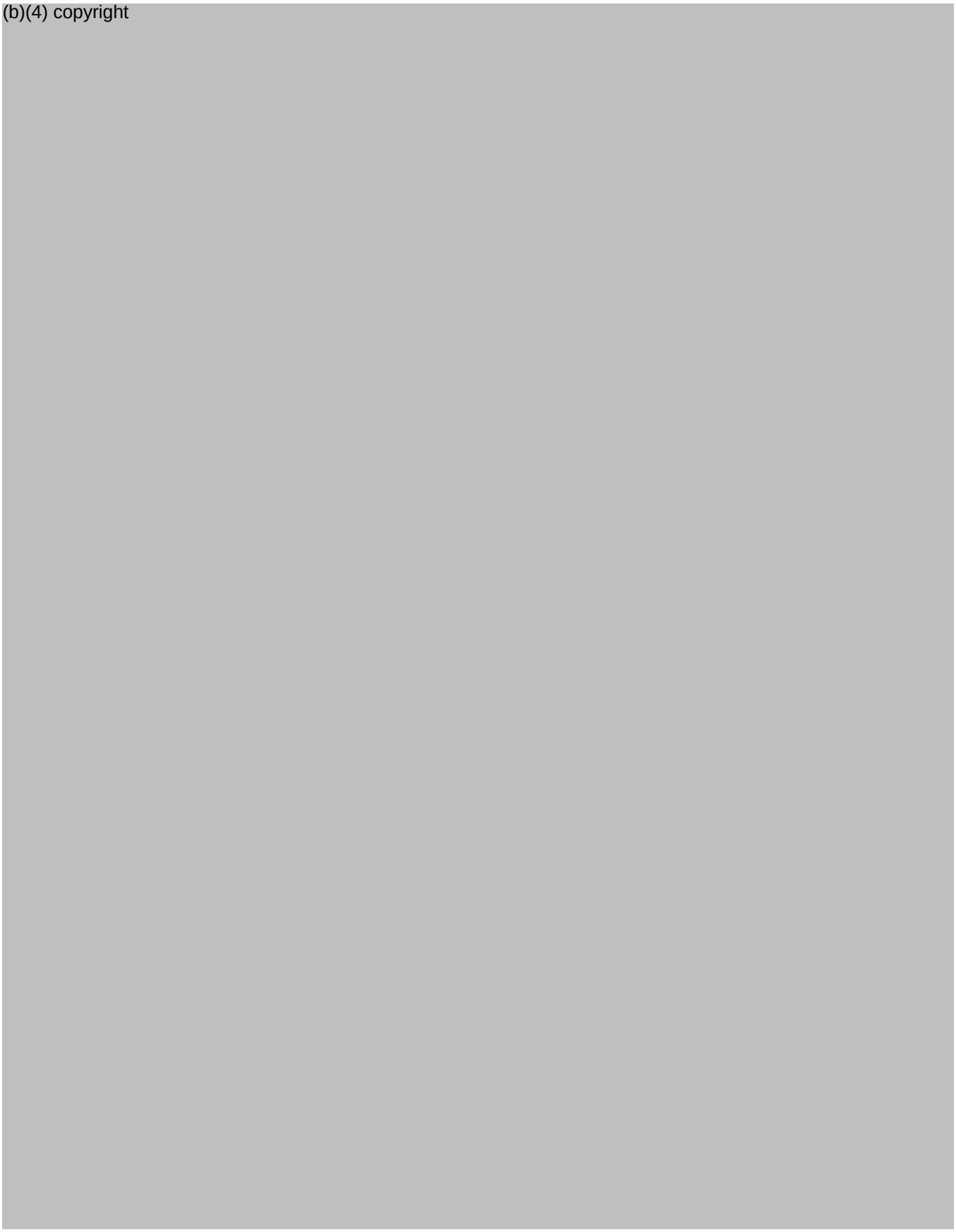

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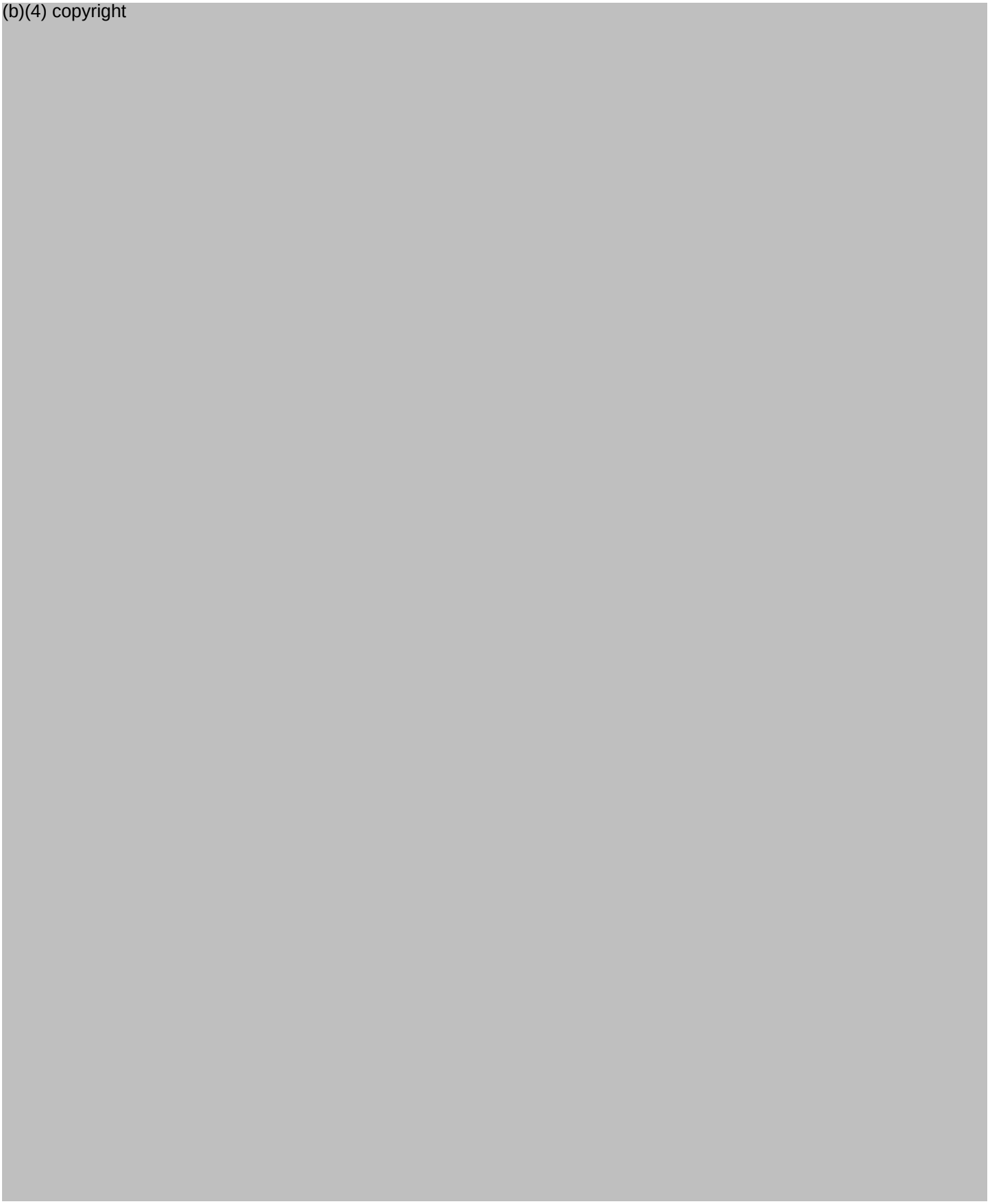

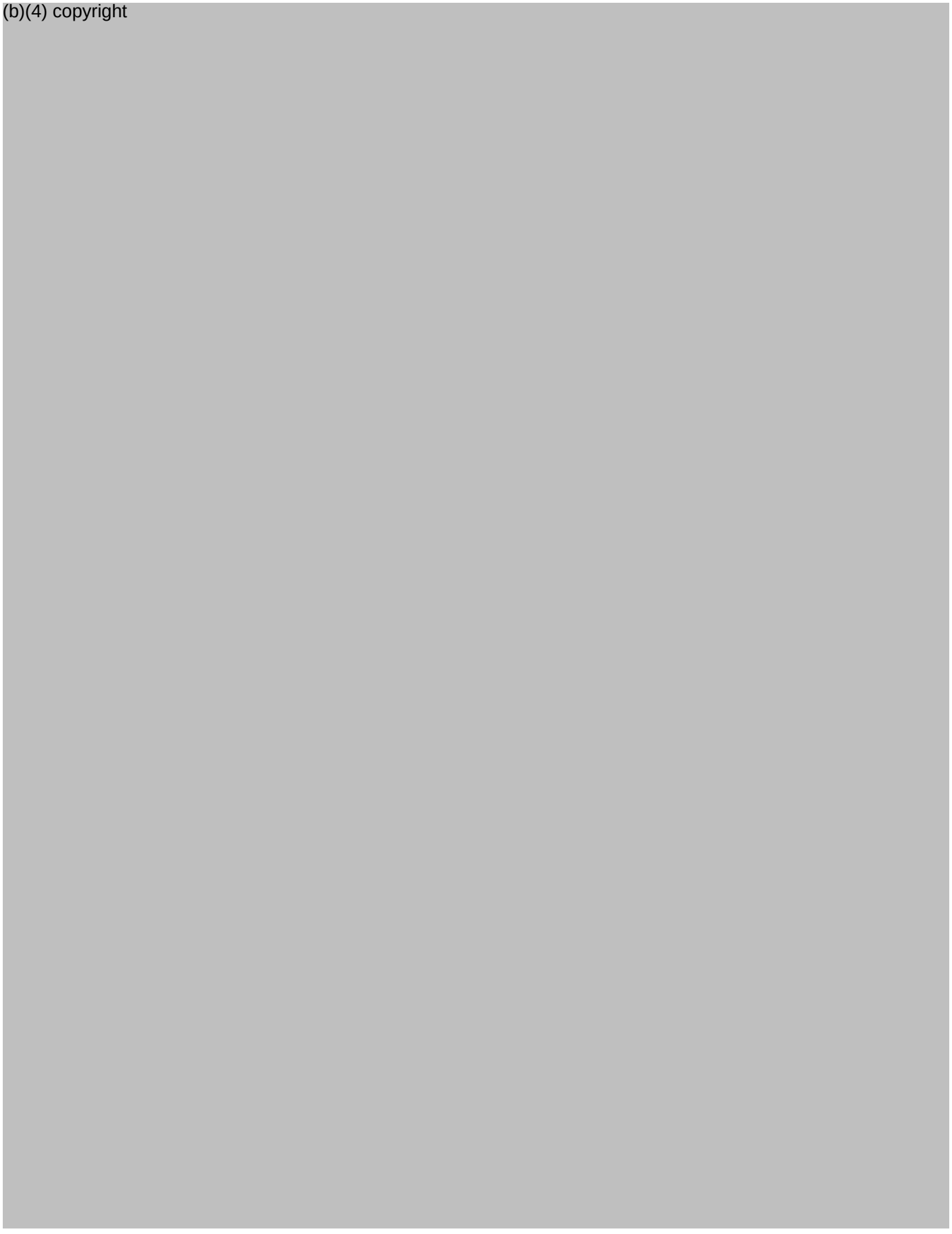

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